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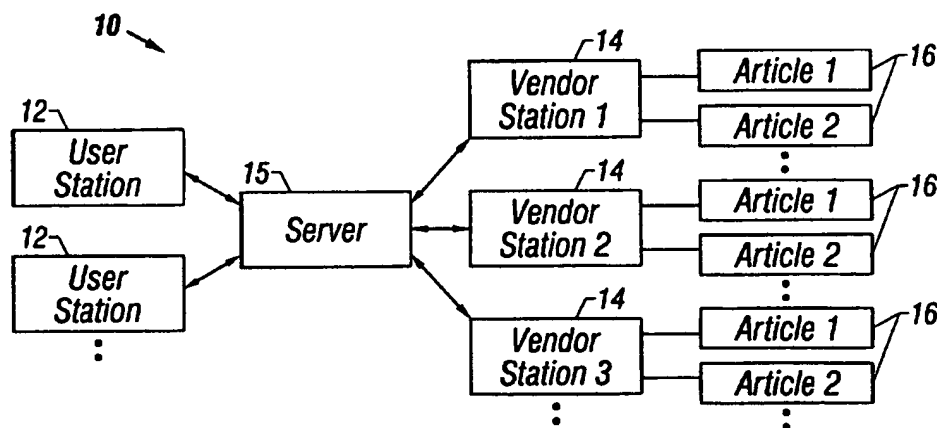
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- (71) Applicant (for all designated States except US):  
**BROWZWEAR INTERNATIONAL LTD.** [IL/IL];  
Nirim Street 3, 67060 Tel Aviv (IL).
- (74) Agents: **WIRTHLIN**, Alvin et al.; Akin, Gump, Strauss,  
Hauer & Feld, L.L.P., P.O. Box 688, Dallas, TX 75313-  
0688 (US).
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- (72) Inventors; and  
(75) Inventors/Applicants (for US only): **FELD**, Avihay  
[IL/IL]; Waizman Street 27, 67060 Tel-Aviv (IL). **NEVO**,  
Noam [IL/IL]; Annaot Street 38, 67060 Tel-Aviv (IL).  
**CEGLA**, Eldar [US/IL]; Pinneless Street 4, 67060  
Tel-Aviv (IL).
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(54) Title: SYSTEM AND METHOD FOR VIRTUAL SHOPPING OF WEAR ARTICLES



(57) Abstract: A system (10) for the electronic shopping of wear articles includes a plurality of vendor stations (14) having a virtual display of wear articles (16) to be sold. First data representing a three dimensional image and at least one material property for each wear article is provided. The system (10) also includes at least one buyer station (12) with access to the vendor stations (14) for selecting one or more of the wear articles and for downloading its associated first data. A virtual three-dimensional model (24) of a person is stored at the buyer station (12) and includes second data representative of three dimensions of the person. The first and second data are compared and the image of the selected wear article (16) is superimposed on the virtual model (24) within constraints imposed by the at least one material property to better approximate the real-life fit and look of the wear article on the person. A method of electronic shopping for wear articles is also provided.

**SYSTEM AND METHOD FOR VIRTUAL SHOPPING**  
**OF WEAR ARTICLES**

**BACKGROUND OF THE INVENTION**

**Field of the Invention**

5           This invention relates to a system and method for apparel shopping, and more particularly to a system and method for electronically ascertaining the fit of wear articles on a person by providing a virtual model simulating the physical body of the person and virtual wear articles reflecting the size, shape and physical characteristics of actual wear articles.

**Description of the Related Art**

10           Apparel shopping for many people is a time consuming task that often involves traveling between various department stores and clothing shops, along with finding and trying on different articles of clothing at each location to determine fit and aesthetic appearance. Often, a person does not know his or her exact clothing size or body measurements. This problem is further augmented by clothing manufacturers that have developed their own  
15           system for sizing. When shopping alone, it is often difficult to determine the proper fit of clothing, especially since viewing the fit of clothing from all angles is not normally available to the shopper. Moreover, purchase decisions are often made in haste, since shoppers may feel uncomfortable with the lack of privacy associated with many dressing rooms. Accordingly, the home shopping industry, including mail order catalogs, television, and the  
20           Internet for purchasing clothing is becoming increasingly popular. Although such services offer more convenience to consumers, such as a relaxing home atmosphere, the avoidance of crowds and traffic, as well as 24-hour operation, the return of clothing items due to improper fit continues to be a problem with both the home shopping industry and stores where clothing is sold.

25           U.S. Patent No. 5,930,769 issued to Rose on July 27, 1999, recognizes that the return of merchandise due to improper fit is one of the biggest problems facing the retail clothing industry. Rose offers a solution to this problem by the provision of a fashion shopping method wherein information from the shopper is gathered, including body measurements, and

then stored in a database at the location of the electronic fashion shopping system. After the personal information is entered, a virtual mannequin of the user is generated, including a digitized photograph of the face. The system then chooses and offers a collection of clothing items out of a larger database based on the personal information. The user can choose a clothing item, which is then integrated with the mannequin and displayed. Although this patent does offer a customized mannequin based on the shopper's body measurements, all of the data related to the shopper is stored at the site of the electronic fashion shopping system. Thus, customers must access and shop at that site only. The storing of data on the store server and the requirement to download all the data relevant to the virtual mannequin as well as the clothing item places further limitations on the efficiency of data and information transfer between the store and shopper.

Systems that provide both a virtual clothing article and virtual mannequin fail to portray how the virtual clothing article will actually stretch, flex and sag in real life when displayed on the virtual mannequin. Rather, prior art systems display stiff virtual clothing articles on virtual mannequins to vaguely approximate how the clothing article will look on a shopper. Moreover, prior art systems that store personal user information, such as body measurements, at the electronic fashion shopping site fail to provide a sense of privacy, since the end user is unaware of who has access to the data or how the data may be used. Thus, there continues to be a need for a system and method that accurately portrays the real-life fit of clothing on a person and that provides for the efficient transfer of data between the store and shopper, conserving bandwidth and enabling the use of personal information in a user-controlled private environment between different store sites that use the same software and/or data format.

#### SUMMARY OF THE INVENTION

In accordance with the present invention, a system and method for determining the fit of a wear article on a person is provided that overcome problems associated with prior art systems and methods.

In accordance with an exemplary embodiment of the invention, a method for determining the fit of a wear article on a person comprises providing a virtual three-

dimensional model of a person, including first data representing three dimensions of the person (which may be the entire person or only a portion of the person, such as the upper torso and arms, lower torso and legs, etc), and selecting a virtual three-dimensional wear article. The virtual wear article has second data representing three dimensions of the wear article and third data representing at least one material property of the wear article. The third data may include a single value or number reflective of the material property, or may contain a plurality of values. The first data is compared to the second data for causing the virtual wear article to conform to the virtual model within constraints imposed by the third data. The virtual wear article is then displayed on the virtual model. With this arrangement, the virtual wear article stretches, flexes, sags, bunches, and so on, on the virtual model to better resemble the real-life fit and look of the wear article on a person.

In accordance with a further embodiment of the invention, a method of electronic shopping for wear articles by a user at a user station comprises providing a virtual model bank with a plurality of virtual models representing different persons, animals, or the like; selecting one of the plurality of virtual models; connecting to at least one vendor station having a plurality of wear articles for sale; selecting one of the plurality of wear articles from the at least one vendor station; downloading data associated with the selected wear article; and displaying the selected wear article on the selected virtual model. In this manner, a single user can shop for wear articles for himself or herself, and for other persons and animals, with confidence that the selected wear article will fit.

In accordance with an even further embodiment of the invention, a method of electronic shopping for wear articles by a user at a user station comprises providing a virtual model of a person; providing a virtual closet for storing virtual wear articles at the user station; selecting a plurality of virtual wear articles from one or more vendor stations; storing the plurality of virtual wear articles in the virtual closet; and displaying one or more of the selected wear articles on the virtual model. With this arrangement, the user can keep a record of wear articles that he or she likes. This is advantageous when an electronic shopping trip must be cut short before making final purchases, especially since the user does not have to reselect the wear articles at the vendor station(s). This arrangement is also advantageous

when the user desires to show others the appearance and fit of the wear article prior to purchase without accessing the vendor station(s).

In accordance with an even further embodiment of the invention, a system for the electronic shopping of wear articles by a user at a user station is provided. The system  
5 includes at least one vendor station having a virtual display of wear articles to be sold and first data representing a three dimensional image and at least one material property for each wear article. The system also includes at least one buyer station having means for selecting at least one of the wear articles and for downloading its associated first data, and a virtual three-dimensional model of a person including second data representative of three dimensions of  
10 the person. Means are provided for comparing the first and second data and causing the image of the selected wear article to be superimposed on the virtual model within constraints imposed by the at least one material property. With this arrangement, the system enables the virtual wear article to stretch, flex, sag, bunch, etc., on the virtual model to better resemble the real-life fit and look of the wear article on a person.

15 Other features and advantages of the invention will become apparent upon reading the following detailed description and appended claims, and upon reference to the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The preferred embodiments of the present invention will hereinafter be described in  
20 conjunction with the appended drawings, wherein like designations denote like elements, and wherein:

FIG. 1 is a schematic block diagram of an electronic shopping system according to an exemplary embodiment of the invention;

FIG. 2 is a schematic block diagram showing details of a user station that forms part  
25 of the system of FIG. 1;

FIG. 3 is a schematic block diagram showing details of a vendor station that may form part of the system of FIG. 1;

FIG. 4 shows a menu screen for the electronic shopping system of FIG. 1;

FIG. 5 is a flow chart illustrating a method for electronic shopping of wear articles;

FIG. 6 is a flow chart illustrating a method for superimposing a virtual three-dimensional wear article on a virtual three-dimensional model;

5        FIG. 7 shows a portion of a virtual model and a virtual wear article to be placed on the model;

FIG. 8 is a cross section of the virtual model and wear article taken along line 8-8 of FIG. 7; and

10        FIG. 9 is a cross section of a virtual model and wear article similar to FIG. 8, with the virtual model being larger in cross dimension.

It is noted that the drawings of the invention are not to scale. The drawings are merely schematic representations of the invention and are intended to portray only typical embodiments, not specific parameters thereof. Accordingly, the drawings should not be considered as limiting the scope of the invention. The invention will now be described in  
15        greater detail with reference to the accompanying drawings.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and to FIG. 1 in particular, a system 10 for the electronic shopping of wear articles includes a plurality of user stations 12 for connection to other user stations 12 and/or a plurality of vendor stations 14, preferably through a server or  
20        operation module 15. As shown, each vendor station has a plurality of wear articles 16 for purchase by a user.

The wear articles 16 may include, but are not limited to, shirts, blouses, pants, trousers, belts, suspenders, ties, socks, shoes, suits, lingerie, underclothing, jackets, jumpsuits, hats, scarves, jewelry such as rings, necklaces, watches, prescription glasses, sunglasses, hair  
25        items, and so on, and/or any other item that can be worn or carried by a person including men, women and children, animals, or the like.

In one exemplary embodiment, each vendor station 14 is an Internet domain site, the user station 12 includes a personal computer that is connectable to the vendor stations through an Internet browser and/or Internet service provider in a well-known manner, and the server module 15 includes software that is operated in a background mode. Preferably, the server module 15 operates from a server location, such as an Internet site, and is connectable to both the user stations 12 and the vendor stations 14 for interconnecting user stations to vendor stations and user stations to user stations. A connection between vendor stations may also be provided through the server module 15. In this manner, services such as searching multiple vendor stations, instant messaging, advertising, tracking buyer habits, and so on, can be provided. Alternatively, the vendor station(s) 14 and server module 15 may be in the form of one or more portable memory devices, such as CD-ROM's, DVD's, floppy disks, flash cards, or other memory devices currently in use or that may be developed in the future that connects to the user station through a virtual connector cable or other well known connection. Likewise, the user station may alternatively be in the form of an interactive television device, a display telephone, or any other interactive display currently in use or that may be developed in the future. Whether the vendor stations and server are Internet sites, portable memory devices, or other suitable systems or components, information relating to the articles for sale can be selectively downloaded to and displayed on the user station, as will be described in greater detail below.

With additional reference to FIG.'s 2 and 4, the user station 12 includes a virtual closet system 20 for storing pre-loaded and/or downloaded wear articles from a vendor, a virtual model bank system 22 for storing one or more virtual models 24 of one or more persons, and a virtual dressing room system 26 that displays one or more of the virtual models together with one or more of the wear articles 16 in a superimposed manner. The model bank system 22 preferably includes a first section 23 with pre-stored generic virtual models and a second section 25 with virtual models that have been modified from the generic virtual models. By way of example, the generic models may include male and female models for infant, toddler, child, pre-teen, teenager, adult, and any other size and/or age.

As shown in FIG. 4, the virtual closet system 20, the virtual model bank system 22, and the virtual dressing room system 26 are operable to generate pop-up or floating user

windows 28 on a computer monitor or other suitable display device. In this manner, the user can view at a glance the stored wear articles, the virtual models, and any wear articles chosen to be displayed on one or more of the virtual models. Each window 28 may be displayed on the monitor independently of the other windows. Preferably, the windows are used in conjunction with one or more vendor windows 30 associated with vendor stations 14.

A typical vendor window may include menus and submenus relating generally to person and clothing types, purchasing information, and so on, together with icons or images representative of wear articles 16 for sale, and details on each wear article. Variations in window content, format, menu items, purchasing policies, and available wear articles may vary greatly from vendor station to vendor station. The present invention is especially suitable for, and adaptable to existing or future vendor stations with minimal change in the vendor database, as will be described in greater detail below. Although separate windows for the virtual closet, model bank and dressing room are displayed simultaneously in FIG. 4, it is to be understood that one window may be shown at a time. Alternatively, a single window may be used to simultaneously display the contents of the closet, model bank and dressing room.

In accordance with an exemplary embodiment of the invention, the virtual models and the virtual wear articles are displayed in the virtual dressing room 28 in three-dimensional format and may be rotated about and/or translated along one or more of three mutually perpendicular axes, as represented by numeral 32, to view the models and superimposed wear articles at any desired angle. Moreover, the contents of the virtual dressing room may be zoomed in or out. Alternatively, the viewpoint may be rotated about and/or translated along one or more of the axes. Changing the orientation and zoom factor of the viewpoint or model and superimposed wear articles may be accomplished by clicking a right and/or left button of a mouse or other cursor positioning device, then dragging the cursor right, left, up, down, or any combination thereof, while the cursor is in the window of the virtual dressing room. The actual wear article to be purchased or removed may be selected by positioning the cursor directly on the superimposed article and clicking the right or left button. The manner in which the one or more virtual three-dimensional wear articles is superimposed on a virtual three-dimensional model will be described in greater detail below in conjunction with FIG. 6.



With reference now to FIG. 3, each wear article 16 of each vendor station 14 may include data representing standard information, such as pricing data 34, availability data 36, color data 38, size data 39, clothing category 44, material pattern 46, general information 48, and any suitable information that may be used in the selection and purchase of wear articles.

5 In addition to the standard information, each wear article 16 may include a three-dimensional data set 40 and a material data set 42. The three-dimensional data set 40 is preferably in vector and geometrical shape format to keep the amount of relevant data to a minimum, which is especially important when downloading a wear article from a vendor station on the Internet. The material data set 42 may contain information about the material such as  
10 material type, e.g. cotton, polyester, rayon, nylon, wool, and other suitable materials, or any combinations thereof, texture, type of weave, number of threads per unit measure, density of the material, stiffness, thread size, sheer strength, stress, strain, elasticity, yield strength, and/or any other suitable material property that may be used to properly analyze the fit of the wear article to a selected person, as will be described in greater detail below. All of the data  
15 associated with the wear article can be contained in one or several files that may be downloaded to the user station. In a preferred embodiment, the user specifies the data to be downloaded, such as size, color, material type, and so on, along with the associated three-dimensional data set, which is then downloaded for display in the virtual closet. If more than one material type is available for the selected wear article, the corresponding material data set  
20 is flagged for downloading when the material type is selected. Although it is preferred that the data associated with the virtual closet be downloaded from the vendor station to the user station, it is to be understood that such data may be stored at the vendor station.

Referring now to FIG. 5, a method for electronic shopping of wear articles is illustrated, which may be implemented in hardware, software, or a suitable combination of  
25 hardware and software, and may be more than one software system operating on a general purpose user computing platform. As used herein, a software system may be implemented as one or more separate lines of code of a software program, one or more subroutines, one or more agents, one or more objects, one or more lines of code operating on different computer platforms, or other suitable software functionality. For example, a software system may  
30 include functionality that is provided by the operating system of the computing platform, plus other application-specific functionality. In one exemplary embodiment, a software system

containing a setup module, a server module, and other suitable modules is downloaded to the user station from an Internet site, a portable memory device, or other suitable source. The software system includes a three-dimensional real-time rendering engine that is capable of taking the data associated with the virtual model and wear articles, calculating the fit of the virtual wear articles on the virtual model, and displaying the data in a real-time simulated three-dimensional format on a computer screen or other suitable display. After the software is downloaded to the user station, the setup module is then run to create the virtual closet, model bank and dressing room, along with the necessary interface to obtain and manipulate wear article data located at the vendor stations, as represented at block 50.

Once the software has been installed, the model bank system prompts the user to create a virtual three-dimensional model of the user or other person at block 52. The model bank system may generate different menus selectable by a user for entering measurement data with different degrees of detail. For example, a first menu screen may prompt a user to enter general information such as name, age, gender, and general size such as extra small, small, medium, large, extra large, and so on. If a more accurate virtual model of a person is desired, the user may also be provided with options to enter information relating to body type, such as muscular, non-muscular, thin, heavy set, and so on. In addition or alternatively, the user may enter information relating to shoulder width (narrow, medium, broad), chest or bust size (small, medium, large), waist size (small, medium, large), hip size (narrow, medium, broad), and so on.

An even more accurate representation may be achieved by a second menu screen wherein the user is prompted to enter size information such as shirt size, pant size, bra size, shoe size, hat size, and so on.

Greater accuracy may be obtained by selecting a third menu screen where the user is prompted to enter the actual measurements of the person. Such measurements may include, but are not limited to head diameter, bust size, chest size, waist size, hip size, arm length, inseam, center front length, foot length, foot girth, arm and leg diameter, and so on. If desired, two separate menus can be provided for entering the detailed information of upper and lower body portions.

After the measurement data is entered, a body sculpting menu in the model bank system may be accessed by the user. The body sculpting menu personalizes body curves by deforming the virtual model subjectively, based on the user's perception of his or her body. The maximum deformation is constrained to the measurements previously entered by the user. By way of example, a protruding stomach may be positioned at infinite locations between extremely low, extremely high, extremely narrow, and extremely wide positions, while preserving the previously entered waist size. Similar adjustments may be made to the chest or bust line, gluteus maximus, hips, and so on. In order to maintain "real" body proportions, upper limits of distortion may be set so that adjustments to body part position, shoulder or hip width, and so on, are not unrealistically distorted.

The three-dimensional likeness of the person's face and head can be approximated with the model bank system before, after or during formation of the body by prompting the user to select standard facial and head features from a menu of features, such as different types of noses, mouths, cheeks, chins, foreheads, ears, eyes, hairstyles, hair color, skin color, and so on. The different types of facial and head features may be stretched or compressed as desired to more closely assimilate the features of an actual person. Alternatively, the model bank system may accept a scanned photo of the person's face and superimpose the scanned photo on the virtual model. If the user station does not include a scanner, a service may be provided where a passport photo or the like is sent to a remote location, transformed into a digital face image, and then sent by e-mail to the user station where it is incorporated into the user's virtual model.

An even more accurate virtual model may be generated by obtaining a three-dimensional scan of a person's physical features and importing the scan data into the user station for manipulation by the software. One emerging technology that may be suitable for creating three-dimensional photo-realistic models and/or wear articles involves taking a series of two-dimensional images and converting the images into three-dimensional objects in a data format that is internet-friendly.

A default model from the generic section 23 of the model bank system 22 may be selected prior to entering the person's body information. Alternatively, one of the default models from the generic section 23 of the model bank system 22 (FIG. 2) may be

automatically selected based on entered age and gender. According to an exemplary embodiment of the invention, the user may view real-time changes to the selected default model as the body information is entered to thereby assimilate the person's physical features.

Alternatively, the changes may occur on the default model after all body information is entered. The data associated with this modified virtual base model can then be stored at the user station, as represented by block 54 (FIG. 5), and becomes the default virtual model for that person. With the virtual model data stored at the user station, it advantageously remains independent of vendor stations, including those that may no longer be in service, is held at a private location where the data cannot be accessed by unknown persons, and is readily accessible for modification should body features change due to pregnancy, dieting, weight gain, growth, or the like.

After a first virtual model has been created and saved, the user can be prompted to create another virtual model with different size information for another person. The other person may be a spouse, child, friend, client, and so on, and therefore the present invention advantageously enables a user to shop for others with substantially more confidence of choosing wear articles that fit.

Once the user station is set up, a user may connect to a vendor station to browse through wear articles, as represented at block 56. For example, a vendor station may transmit data and code in HTML format or other suitable format to the user station. This data may be used to generate one or more images by the user's web browser software system or other suitable systems. A desired wear article 16 may then be selected by the user at block 58 through manipulation of a computer mouse, pointing device, joystick, voice command, or other selection means. At block 60, the software is executed to display the dressing room 26, the personal closet 20, and/or the model bank 22, depending on the user's preference.

Execution of the software can take place before the user station is connected to the vendor station (represented by dashed arrow 66), or before the user selects a desired wear article (represented by dashed arrow 68), or after the wear article is selected (represented by dashed arrow 70). In the preferred embodiment, the software automatically executes after a wear article is selected, either from the virtual closet at the user station, or at the vendor station.

Subsequently, the data associated with the wear article is downloaded to the user station and

manipulated by the software to display the virtual three-dimensional wear article on the virtual three-dimensional model in the virtual dressing room, as represented at block 62.

In one exemplary embodiment of the invention, a background can be displayed in the virtual dressing room according to the type of wear article selected, such as formal wear, casual wear, business clothing, and so on. For example, if a swimsuit is selected, the background may include imagery representative of a pool or beach. Likewise, if a business suit is selected, the background may include imagery representative of an office environment. The background may be selected by a user or automatically displayed when the particular clothing style is selected. In addition to creating a background for the virtual model and wear article, the amount and direction of virtual incident lighting may be automatically displayed or adjusted by the user.

In accordance with a further exemplary embodiment of the invention, the model and superimposed wear article(s) may have different pose positions that can be selectable by the user. For example, the user may select between a first pose wherein the model is standing straight with hands on hips, a second pose wherein the model is standing straight with hands hanging down, and a third pose wherein the model is sitting. In an alternate arrangement, the model may be animated to move in real time between different predetermined positions or poses to thereby enable the user to assess the fit of wear articles through different ranges of motion. By way of example, the model may be animated for walking, running, sitting down, standing up, turning, exercising, and so on, or any combinations thereof. Different poses or animations may be associated with different backgrounds, as previously described. Whether the model has different discreet pose positions or is animated, the position of the superimposed wear article(s) is simulated in real time. A virtual reset button may be associated with the virtual dressing room for returning the model and wear article(s) to a default position.

After one or more virtual wear articles have been displayed on the virtual model, the user may select different options, as shown at block 64. Hot spots may be provided on the virtual wear article that can be selected by the user. For example, the user may decide to select the sleeves of a shirt or blouse or the legs of pants to roll them up once. Second and third selections may roll the sleeves or legs over two and three times, while a fourth selection

may return the sleeves or legs to their default position or roll them down once. Likewise, the hot spots may be associated with buttons, zippers or other fasteners on the wear article where a first selection of the hot spot opens the fastener and a second selection closes the fastener. Other hot spots may be associated with a lower portion of a shirt or blouse for tucking or untucking. The material itself may be repositioned within constraints by clicking and dragging on various portions of the virtual wear article. In this manner, the virtual wear article may be viewed as a user would actually wear the article. Another option available to the user may include selecting a displayed purchase button associated with the server module 15 for connecting to a vendor station to purchase or place the wear article in a shopping cart at the vendor station. Other options available to the user may include storing the wear article in the virtual closet, or discarding the wear article.

Another virtual wear article may then be selected from the same vendor station or a different vendor station, tried on the virtual model, and then purchased, stored, or discarded. This process can continue for as long as there is available memory and storage space at the user station. A unique advantage of this arrangement enables a user to mix and match wear articles from different vendor stations. For example, a shirt may be selected from one vendor station, a tie from another vendor station, a suit from yet another vendor station, socks and shoes from a further vendor station, a watch from another, and so on. The information from all of these items may be downloaded and individually or simultaneously displayed on the virtual model to determine the fit, appearance, color coordination, and so on, of the different items, or may be downloaded into the virtual closet for offline fitting. Preexisting vendor stations need only add three-dimensional wear article data together with material property data to be compatible with the three-dimensional virtual model of the present invention.

When it is desired to determine the appearance of different wear article combinations from wear articles stored in the virtual closet, such wear articles may be displayed and oriented in their approximate wear positions in the closet before simulation on the virtual model.

When searching for wear articles, the software may provide a list of vendor stations through the server module 15 that offer products in a compatible three-dimensional format, as

well as searching capabilities among participating or other vendor stations for particular wear articles, sales, and so on.

5       The selection of wear articles from a vendor station, or the transfer of wear articles from the dressing room to the closet and vice-versa, can be accomplished by clicking on the wear article image or icon representative of the wear article, by clicking and dragging the image or icon to the appropriate location, or by other suitable data handling methods.

10       According to an exemplary embodiment of the invention, information relating to virtual wear articles that are stored in the virtual closet can be automatically displayed in a pop-up window by positioning the cursor over the icon, image, or file name representative of the virtual wear article. Such information may include manufacturer name, brand name, style, size, available textures, colors, original web site address, pricing, and the like. By clicking one of the buttons associated with the mouse or other cursor control device, a list of activities relevant to the wear article can be displayed. Such activities may include, but are not limited to, sending the wear article to one or more users that may be either online or  
15       offline, categorizing the wear article, deleting the wear article, adding the wear article to a virtual shopping cart, choosing a desired color, choosing a desired size, and positioning the wear article on the model.

20       The software may also enable other online shoppers to visit the virtual dressing room of a user through the server module 15 (FIG. 1), upon the user's request, and supply comments relating to the fit, appearance, and so on of the wear article(s) on the virtual model. In this manner, the user does not have to rely on his or her opinion alone when deciding whether one or more wear articles should be purchased. This may be accomplished by providing an online alert or status window listing other users that are currently online, whether at the same or different vendor stations. A chat window may also be provided. The  
25       software may also enable a user to send three-dimensional rendered images to others who do not have the software.

      When the software provides an online alert or status window listing other users, the software may also enable each user to select between different levels of availability. For example, a user may select between offline, online available, online invisible, online busy,

online away from computer, and online protection wall. The online available status enables communication between different users, while the online protection wall automatically declines all messages and files from other users. When in the online available mode, the software may also enable linking capabilities for two or more users in order to "shop" together at one or more vendor stations. In this instance, it is preferable that the users be linked together in a master-slave mode so that moving from one vendor station to another is conducted simultaneously by all linked users. By way of example, a first online user may issue an invitation to another online user to surf internet clothing shops together. By accepting the invitation, the invitor may become the master and the invitee may become the slave. When shopping together, the virtual dressing room of each linked user is preferably viewable to all other linked users.

Push services can also be provided by the software to enable the circulation via E-mail, letters, or other advertising means of announcements regarding clearance sales, new designs, and so on, by vendor stations previously visited by the user, or to announce the addition of new vendor stations with compatible databases. The push services can include monitoring buying habits over time of the customer station, such as when a "purchase" button on a display screen associated with the server module is selected by a user. The buying habits may include, but are not limited to type of clothing articles purchased or downloaded, name brand, color, pattern, vendor location where the purchase or download occurred, purchase price, and so on. The buying habits may be statistically analyzed and sent to vendor stations for use in targeting individuals for promotions related to particular wear articles. By way of example, a user station may download or try on several black pants in a particular size and style from one or more vendors. It can then be determined that black pants may be a desirable item to push or advertise at the user station. Custom E-mail or other advertising means may then be arranged for informing the target user station that black pants are currently on sale in the size and style previously selected by the user.

When a person at the user station decides to make a purchase of a particular wear article, that wear article is preferably highlighted and the purchase button (not shown) associated with the server module 15 and displayed on the display screen is selected. The purchase button is preferably in the form of a changeable hyperlink, the address of which



depends on the particular wear article highlighted or otherwise chosen for purchase. Selection of the purchase button displays the vendor site where the wear article was first viewed or downloaded. The user may then select a separate purchase button at the vendor station to complete the transaction. This feature is particularly advantageous since a person  
5 may no longer remember which wear articles are associated with which vendor station, especially when a number of wear articles are stored in the virtual closet.

Turning now to FIG.'s 6 to 9, an exemplary method of superimposing one or more virtual three-dimensional wear articles on a virtual three-dimensional model is illustrated. As shown in FIG. 7, the data set 40 for a selected wear article 16 includes a number of data  
10 points 80 that define the three-dimensional shape of the wear article. The virtual model 24 also includes a data set 82 with a number of data points or vertices 84 that denote the center of gravity of a corresponding polygon 85. The polygons 85 define the three-dimensional shape of the model. The number of polygons of the virtual model and the number of vertices of the wear article can vary depending on the desired accuracy and resolution of the person  
15 and article they represent, respectively, and the computing power available at the user station, since a larger number of polygons and vertices require more processing time on the same processor.

According to an exemplary embodiment of the invention, the three-dimensional data set includes two-dimensional data representative of different wear article portions, such as  
20 pattern pieces associated with the back, front, sleeves, collar, and so on. The three dimensional data set also includes information on where each pattern piece fits and how the pieces are "stitched" together. A technique for assembling virtual clothing patterns into a three-dimensional image is disclosed in U.S. Patent No. 5,615,318 to Matsuura, the disclosure of which is hereby incorporated by reference.

25 After downloading the data for a selected wear article, including the three-dimensional data set 40 and the material data set 42 as shown at block 90, the size of the wear article is compared to the size of the model, as shown at block 92. If it is determined at decision block 94 that the size of the wear article is outside a predetermined range, the fitting routine is aborted, as shown at block 96. This can be accomplished by attempting to "stitch"  
30 the two-dimensional patterns together to form the three-dimensional wear article around the

model. If the seams between adjacent patterns cannot come together, i.e. the data points do not converge, it is determined that the wear article is too small. The user may then be informed that the selected article will not fit the selected model and may be prompted to choose a different size.

5           If it is determined at block 94 that the wear article is in the predetermined range, then a new position for each vertex of the wear article is calculated at block 98, and as shown by differences in spacing S1 in FIG. 8 and spacing S2 in FIG. 9. The new position is calculated in conjunction with a collision routine as shown at block 100. Since the vertices move in three-dimensional space, the collision routine assures that none of the vertices will intersect or collide with each other, the model, or other wear articles so that the wear article does not intersect with either itself, the model, or with other wear articles. Collision detection with the model is preferably accomplished by testing one or more polygons 85 of the model in the area of a vertex 80. The most proximal polygon(s) 85 for a vertex 80 can be found by defining a boundary circle around the vertex, taking an array of polygons 85 proximal the vertex 80 and comparing the distance from the center of gravity 84 to the vertex until one or more polygons are found with centers of gravity located in the imaginary boundary circle. Near polygons can then be found by locating centers of gravity outside of the boundary circle. If the vertex 80 attempts to move beyond the boundary circle, then the vertex area is no longer valid and must be rebuilt. If the vertex does intersect with the model, then the vertex is repositioned outside of the model within a predetermined space threshold T (see FIG. 8). The size of the grid comprising vertices 80 may be dynamically changed during the iteration process in order to conserve computational time and processor memory, especially with larger areas of the model that exhibit relatively little change. Collision detection of the wear article with itself or other wear articles is preferably accomplished by detecting the relative positions of the vertices.

25           During vertex repositioning, one or more properties of the material are preferably monitored to determine if a material limit has been exceeded, as shown at block 102. Properties of the material that can be monitored may include, but are not limited to weight or density, stress, strain, elasticity, sheer strength, yield strength, and/or any other material property that may be necessary to properly analyze the fit of the wear article to the model. A

property analysis, including distortion or stretching of the material, can be performed at each vertex 80 or at a selected grouping of vertices 80 of the wear article through well-known three-dimensional finite element analysis routines or the like.

5 In some instances, it may also be desirable to perform a property analysis on the model in order to simulate any skin and/or bone deformation that may occur with a wear article. This may be especially advantageous when the wear article is a body support device such as a brace, girdle, bra, chair, bed, and so on. If the material property, such as the elastic limit of the wear article has been exceeded at decision block 104, the fitting routing is aborted, as shown at block 96, and the user may be informed that the selected wear article  
10 will not fit. If the material property limit has not been exceeded for an accumulated change of all vertices, it is then determined at block 105 if prior movement of the vertices is below a predetermined threshold. If not, a new position for the vertices is calculated at block 98, as previously described. This reiteration process continues until vertices movement is below the predetermined threshold, whereupon the model and the superimposed deformed wear  
15 article(s) are displayed, as shown at block 106. Preferably, sheer and gravitational forces are taken into account for each vertex so that the wear article hangs naturally on the model. The amount of sagging and/or bunching may be compromised by the material stiffness, thickness, or the like, and therefore may be taken into consideration to render a more accurate likeness of the wear item on a person.

20 When it is desirable to superimpose more than one virtual wear article on a virtual model, each wear article may be assigned an overlapping hierarchy value, which may be adjustable by the user. For example, wear articles such as underwear, bras, supporters, swim suits, stockings, hats, glasses, watches, socks, and so on, may be given a high value; wear articles such as overalls, pants, shirts, dresses, skirts, shoes, and so on, may be given an upper  
25 middle value; wear articles such as suit jackets, sweaters, blazers, belts, scarves, and so on, may be given a lower middle value; and wear articles such as coats and jackets may be given a low value. In this manner, a lower value wear article can be superimposed over and cover a higher value wear article on the virtual model. It is to be understood that the values may alternatively be ascending instead of descending for determining the overlapping sequence of  
30 wear articles.

With the above-described arrangement, the suitability and fit of selected wear articles can be determined with greater ease and accuracy than prior art systems. In particular, the manner in which the material of a virtual wear article fits, drapes, sags, stretches, and so on, about the virtual model more closely simulates the actual user or person trying on wear articles in a clothing store. Accordingly, the user is able to make better decisions about purchasing wear articles over the Internet or other remote locations, thereby reducing the likelihood of returns due to improper fit.

While the invention has been taught with specific reference to the above-described embodiments, those skilled in the art will recognize that changes can be made in form and detail without departing from the spirit and the scope of the invention. Thus, the described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes that come within the meaning and range of equivalency of the claims are to be embraced within their scope.

**CLAIMS**

The embodiments for which an exclusive property or privilege is claimed are defined as follows:

1. A method of determining the fit of a wear article for a person, the method comprising:
  - providing a virtual three-dimensional model of a person, including first data representing three dimensions of the person;
  - 5        selecting a virtual three-dimensional wear article, said virtual wear article having second data representing three dimensions of the virtual wear article and third data representing at least one material property of the virtual wear article;
  - comparing the first data to the second data;
  - causing the virtual wear article to conform to the virtual model within
  - 10       constraints imposed by the third data; and
  - displaying the virtual wear article on the virtual model.
2. A method according to claim 1, wherein providing the virtual three-dimensional model comprises entering data representative of the size of the person.
3. A method according to claim 2, wherein the representative data is a standard clothing size of the person.
4. A method according to claim 2, wherein the representative data includes at least one body measurement of the person taken from the group consisting of head diameter, bust size, chest size, waist size, hip size, arm length, inseam, center front length, and foot length.
5. A method according to claim 2, wherein the representative data includes data generated from a three-dimensional scan of the person.
6. A method according to claim 2, wherein the representative data is stored at a user station.
7. A method according to claim 6, wherein selecting the virtual wear article includes downloading the second and third data to the user station.

8. A method according to claim 7, wherein the second and third data are downloaded from a portable memory device.

9. A method according to claim 7, wherein the second and third data are downloaded from a first Internet site.

10. A method according to claim 9, and further comprising:

selecting a second virtual three-dimensional wear article, said second virtual wear article having fourth data representing three dimensions of the second virtual wear article and fifth data representing at least one material property of the second virtual wear article;

comparing the fourth data to at least one of the first and the second data;  
causing the second virtual wear article to conform to the virtual model within constraints imposed by the fifth data; and  
displaying the second virtual wear article on the virtual model.

11. A method according to claim 10, wherein the fourth and fifth data are downloaded to the local computer from a second Internet site different from the first Internet site.

12. A method according to claim 1, and further comprising adjusting body curves of the virtual model by dynamically deforming the virtual model.

13. A method according to claim 1, wherein the virtual wear article includes at least one fastener, and further comprising selecting the at least one fastener for opening and closing the fastener on the virtual wear article.

14. A method according to claim 1, wherein the virtual wear article includes one of a sleeve and a leg, and further comprising rolling the sleeve or leg upon selection of one of the sleeve and leg, respectively.

15. A method according to claim 1, and further comprising:

selecting a second virtual three-dimensional wear article, said second virtual wear article having fourth data representing three dimensions of the second wear article and fifth data representing at least one material property of the second wear article;

- 5                    comparing the fourth data to at least one of the first and the second data;  
                     causing the second virtual wear article to conform to the virtual model within  
constraints imposed by the fifth data; and  
                     displaying the second virtual wear article on the virtual model.

16. A method according to claim 15, wherein the at least one material property of the third and fifth data is selected from the group consisting of stress, strain, elasticity, yield strength, sheer strength, and density.

17. A method according to claim 15, wherein the first and second virtual wear articles are displayed simultaneously on the virtual model.

18. A method according to claim 1, wherein the at least one material property of the third data is selected from the group consisting of stress, strain, elasticity, yield strength, sheer strength, and density.

19. A method according to claim 1, and further comprising rotating, in real time, one of a viewpoint and the displayed wear article and model about at least one of three mutually perpendicular axes of rotation to thereby expose different views of the displayed wear article and model.

20. A method according to claim 19, and further comprising translating, in real time, one of the viewpoint and the displayed wear article and model along at least one of the three mutually axes.

21. A method according to claim 19, and further comprising reducing and enlarging, in real time, the displayed wear article and model.

22. A method according to claim 1, wherein providing the virtual three-dimensional model includes providing a plurality of virtual three-dimensional models representative of different persons.

23. A method according to claim 22, and further comprising simultaneously displaying the plurality of virtual three-dimensional models.

24. A method according to claim 1, and further comprising selecting a pose from a plurality of poses for the virtual three-dimensional model and conforming the virtual wear article to the selected pose.

25. A method of electronic displaying wear articles by a user at a user station, the method comprising:

providing a virtual model bank at the user station with a plurality of virtual models;

5 selecting one of said plurality of virtual models;  
connecting to at least one vendor station having a plurality of wear articles;  
selecting one of said plurality of wear articles from said at least one vendor station;

10 downloading data associated with said selected wear article to said user station; and

displaying said selected wear article on said selected virtual model.

26. A method according to claim 25, wherein said vendor station is an Internet site remote from the user station.

27. A method according to claim 25, and further comprising storing the selected wear article in a virtual closet.

28. A method according to claim 24, wherein said virtual closet is located at one of said user station and said vendor station.

29. A method according to claim 25, wherein said displaying includes providing a virtual dressing room for viewing said selected wear article on said selected virtual model.

30. A method according to claim 29, and further comprising providing at least one other user with online access to said virtual dressing room for viewing said selected wear article on said selected virtual model.

31. A method according to claim 25, wherein said displaying includes displaying said selected wear article on said selected virtual model in three-dimension.



32. A method according to claim 31, and further comprising rotating, in real time, one of a viewpoint and the displayed three-dimension wear article and model about at least one of three mutually perpendicular axes of rotation to thereby expose different views of the displayed wear article and model.

33. A method according to claim 32, and further comprising translating, in real time, one of the viewpoint and the displayed wear article and model along at least one of the three mutually axes.

34. A method according to claim 25, and further comprising reducing and enlarging, in real time, the displayed wear article and model.

35. A method according to claim 25, and further comprising:

selecting a plurality of wear articles from said at least one vendor station;

downloading data representative of said plurality of selected wear articles to said user station; and

5

storing the plurality of selected wear articles in the virtual closet.

36. A method according to claim 35, and further comprising selecting a plurality of wear articles stored in said virtual closet; and wherein said displaying includes displaying said selected plurality of wear articles from said virtual closet on said selected virtual model.

37. A method according to claim 35, and further comprising determining wear article preferences by monitoring the selection of wear articles by the user station.

38. A method according to claim 37, and further comprising sending at least one advertisement to the user station relating to wear articles based on the determined wear article preferences.

39. A method according to claim 25, and further comprising selecting a pose from a plurality of poses for the virtual three-dimensional model and conforming the virtual wear article to the selected pose.

40. A method of electronic displaying wear articles by a user at a user station, the method comprising:

- 5      providing a virtual model of a person;  
providing a virtual closet for storing virtual wear articles;  
selecting a plurality of virtual wear articles from one or more vendor stations;  
storing said plurality of virtual wear articles in said virtual closet; and  
displaying one or more of said selected wear articles on said virtual model.

41. A method according to claim 40, wherein said virtual closet is located at said user station.

42. A method according to claim 40, wherein said displaying includes providing a virtual dressing room for viewing said one or more selected wear articles on said virtual model.

43. A method according to claim 40, and further comprising providing at least one other user with online access to said virtual dressing room for viewing said one or more selected wear articles on said virtual model.

44. A method according to claim 40, wherein said displaying includes displaying said one or more selected wear articles on said virtual model in three-dimension.

45. A method according to claim 44, and further comprising rotating, in real time, the displayed three-dimension model and one or more wear articles about at least one of three mutually perpendicular axes of rotation to thereby expose different views of the displayed model and one or more wear articles.

46. A method according to claim 44, and further comprising translating, in real time, the displayed three-dimension model and one or more wear articles about at least one of three mutually perpendicular axes of translation.

47. A method according to claim 40, and further comprising selecting a pose from a plurality of poses for said virtual model and said selected wear articles.

48. A system for the electronic shopping of wear articles, the system comprising:  
first data representing a three dimensional image and at least one material property for each wear article;

at least one buyer station having:

5 means for selecting at least one of said wear articles and for  
downloading its associated first data;

a virtual three-dimensional model of a person, including second data  
representative of three dimensions of the person; and,

10 means for comparing the first and second data and causing the image  
of the selected wear article to be superimposed on the virtual model within constraints  
imposed by the at least one material property.

49. A system according to claim 48, and further comprising at least one vendor  
station, the vendor station having a virtual display of wear articles to be sold and said first  
data for each wear article.

50. A system according to claim 48, wherein said at least one vendor station is  
located on a portable memory device.

51. A system according to claim 48, wherein said at least one vendor station is  
located at an Internet site.

52. A system according to claim 51, wherein said at least one buyer station comprises  
a personal computer adapted for connection to the Internet site.

53. A system according to claim 52, and further comprising means for monitoring the  
selection of wear articles by the user station to thereby determine wear article preferences.

54. A method according to claim 48, and further comprising means for sending at  
least one advertisement to the user station relating to wear articles based on the determined  
wear article preferences.

55. A system according to claim 48, wherein said at least one buyer station further  
comprises a virtual closet for storing images of selected wear articles.

56. A system according to claim 55, wherein said at least one buyer station further  
comprises a virtual dressing room for viewing the selected wear article and model.

57. A system according to claim 56, wherein said at least one buyer station further comprises a virtual model bank for storing images of a plurality of virtual models.

58. A system according to claim 48, wherein said at least one buyer station further comprises a virtual dressing room for viewing the selected wear article and model.

59. A system according to claim 58, wherein said virtual dressing room is accessible by more than one buyer station.

60. A system according to claim 48, wherein said at least one buyer station further comprises a virtual model bank for storing images of a plurality of virtual models.

61. A system according to claim 48, wherein the at least one material property is selected from the group consisting of stress, strain, elasticity, yield strength, sheer strength, and density.

62. A system according to claim 48, wherein said virtual three-dimensional model includes a plurality of selectable poses.

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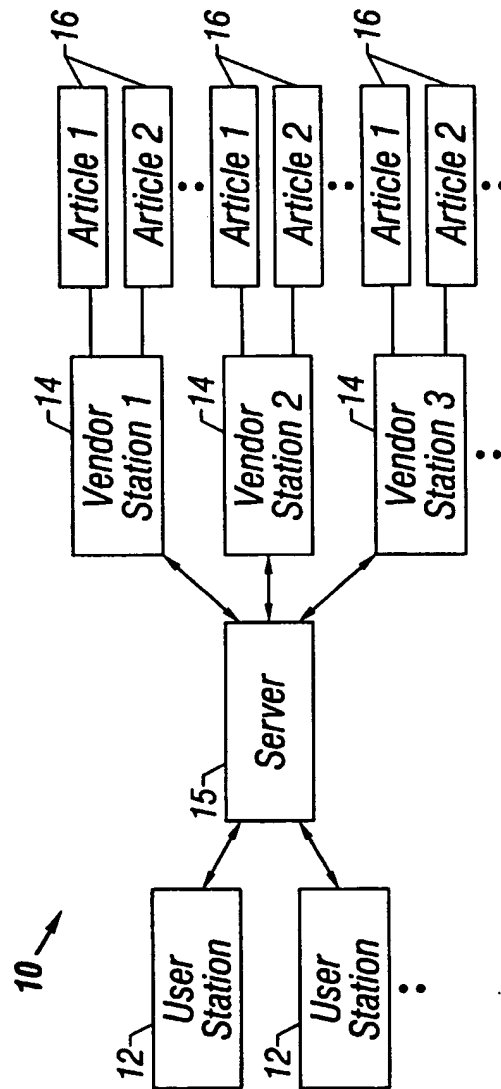


FIG. 1

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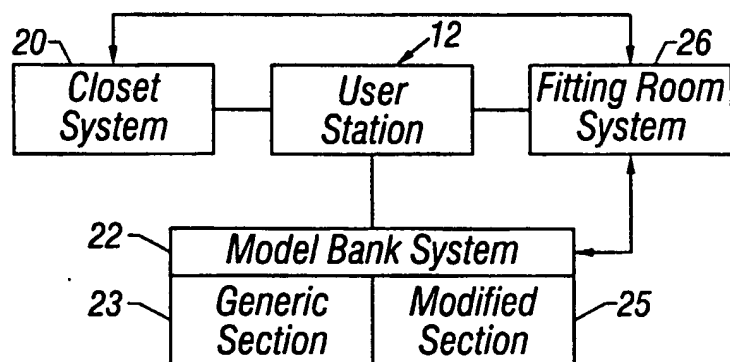


FIG. 2

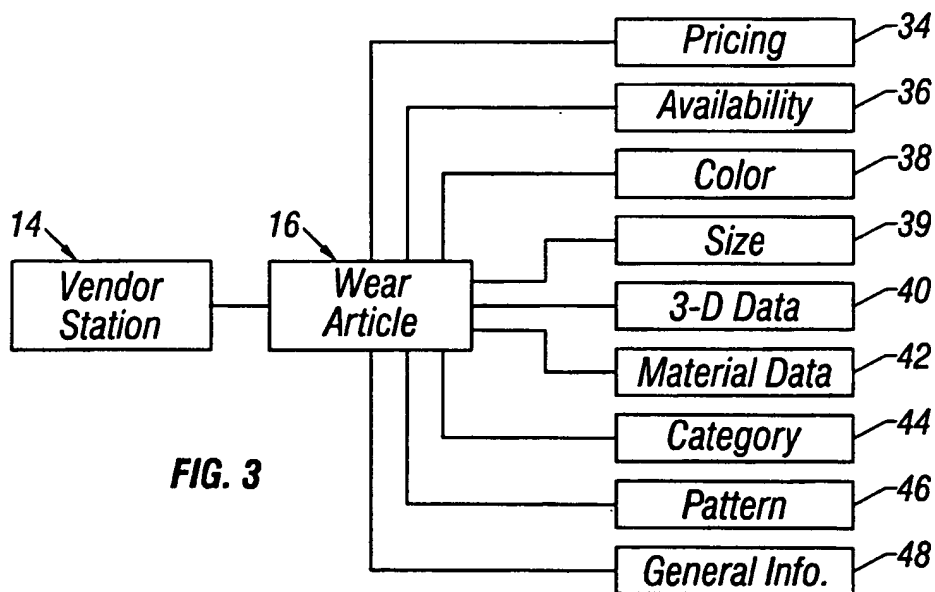


FIG. 3

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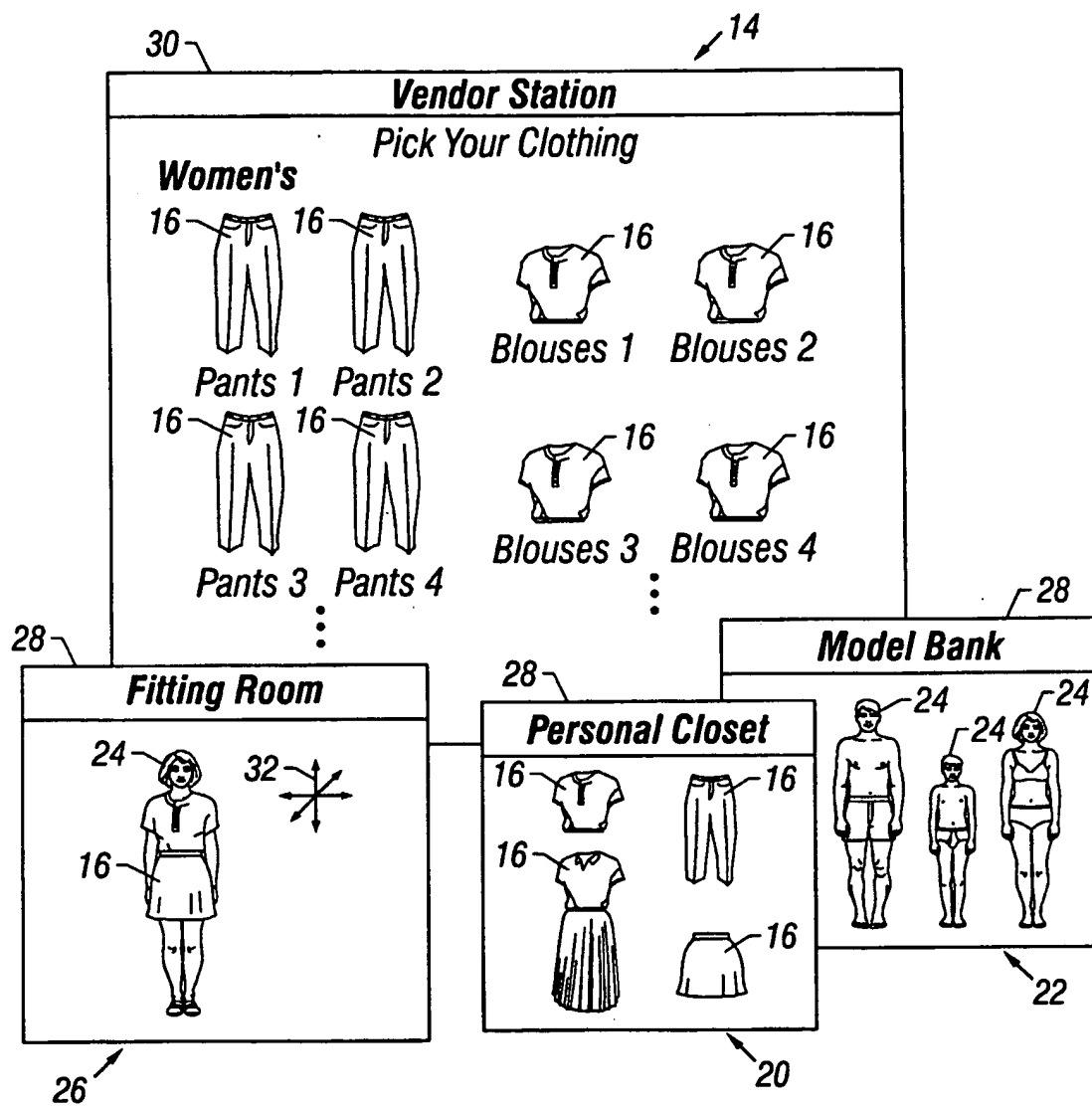


FIG. 4

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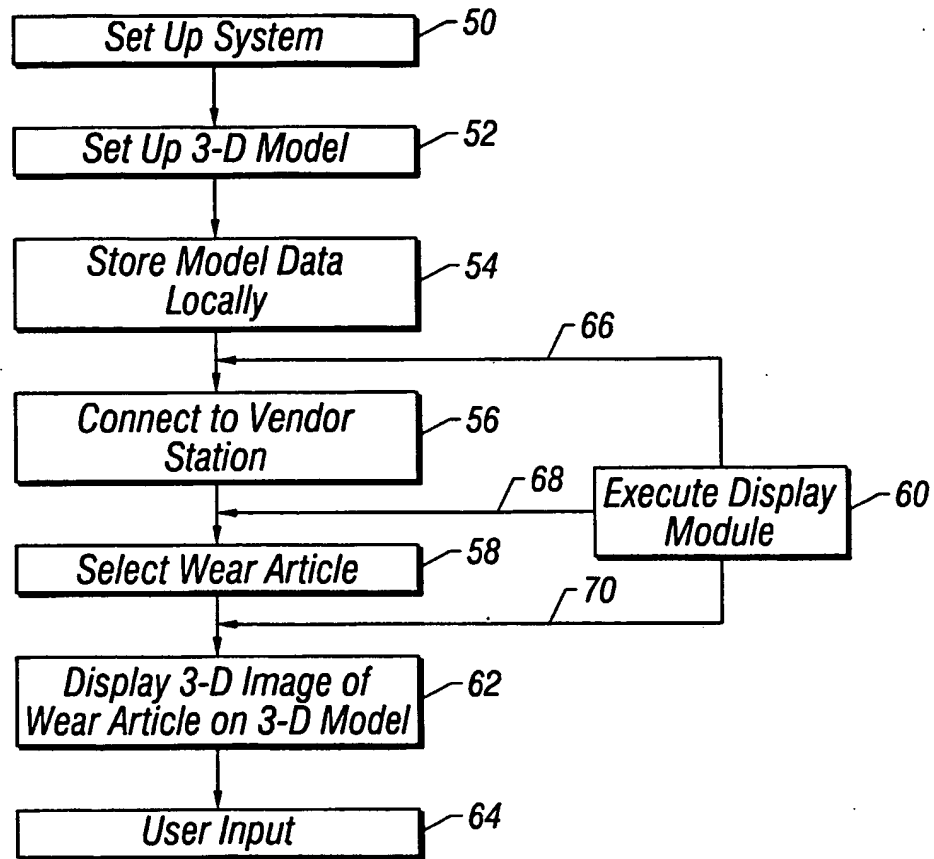


FIG. 5



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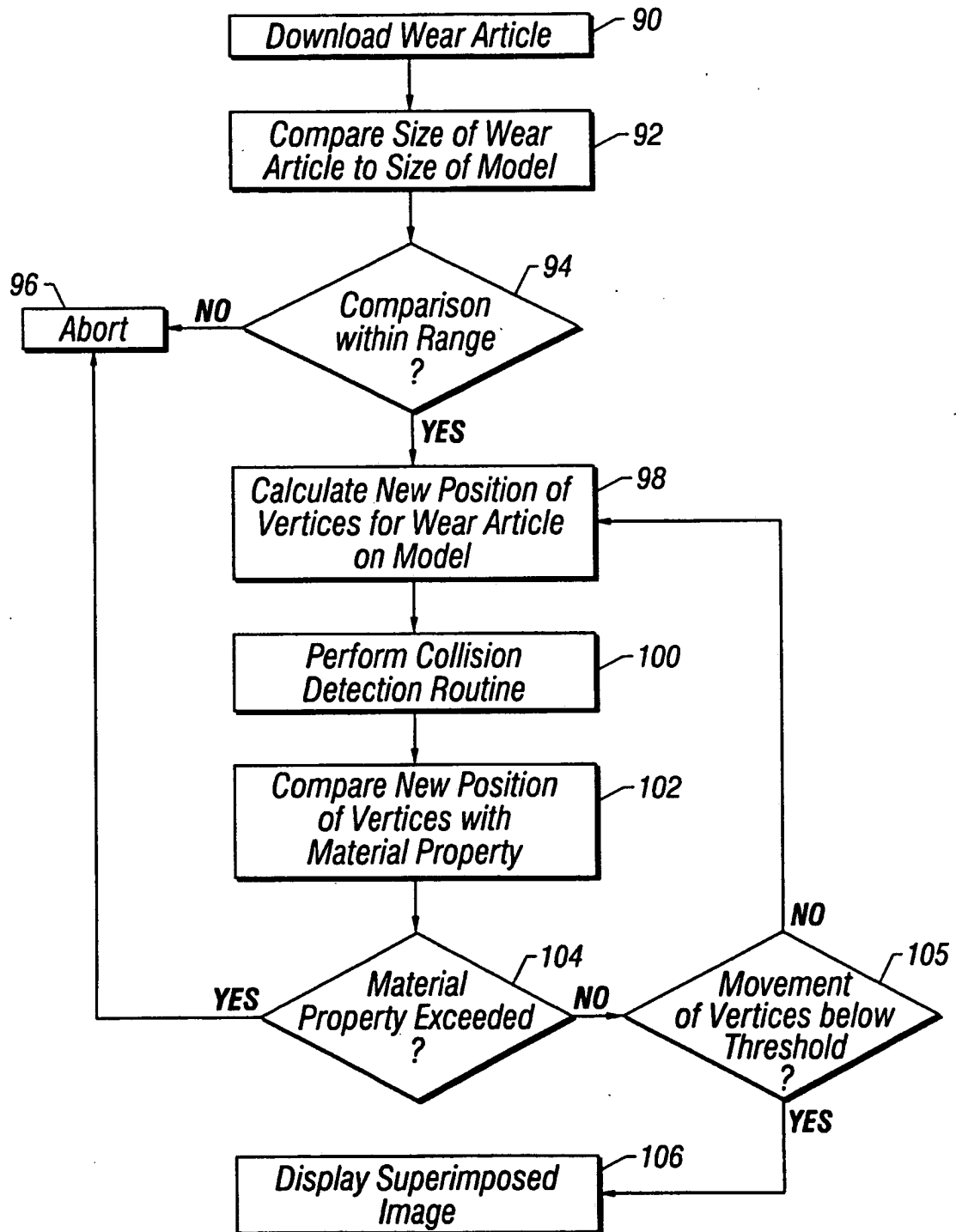


FIG. 6

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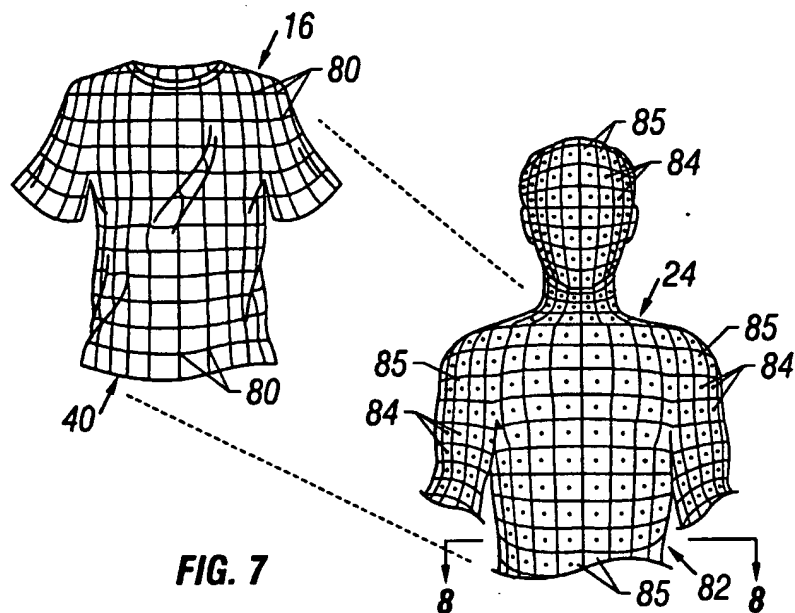


FIG. 7

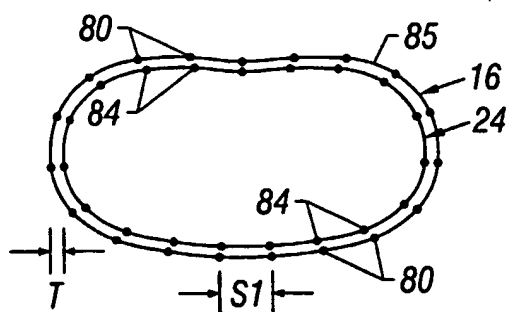


FIG. 8

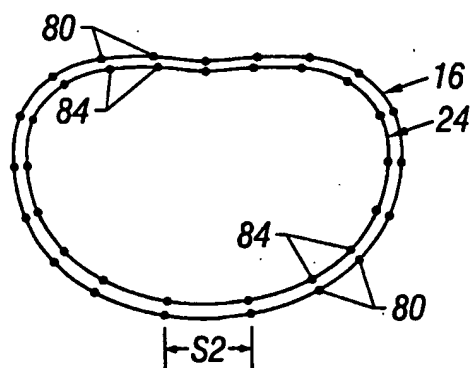


FIG. 9

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US01/05336

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G06F 17/60

US CL :705/26

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 705/26-29

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG

EAST: apparel, wear, 3-dimension, virtual

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,930,769 A (ROSE) 27 JULY 1999, col.7, lines 1-23.	1-62

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

## \* Special categories of cited documents:

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21 MAY 2001

Date of mailing of the international search report

13 JUN 2001

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A. J. HEINZ

*James R. Matthews*

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